Research Note

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

Missoula, Montana

No. 87 January 1951

LIGNIN FOR GOLF GREENS AND OTHER HORTICULTURAL USES

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Wood is made up of about one-third lignin and two-thirds cellulose. When treated with dilute sulphuric acid under controlled conditions, the acid works on the cellulose and makes sugar. What's left is lignin. It looks like ground-up well-rotted wood with the color of coffee grounds. As a matter of fact, it is decayed wood, except that the process of cellulose breakdown has been hastened many years by the chemical action of weak sulphuric acid. Decayed wood and other organic materials form the humus component of many of our soils. Lignin of chemical origin is thought to be a good source of humus, also a means of modifying soil pH.

pH is a measure of soil acidity or alkalinity. A soil having a pH of 7 is neutral. As the number decreases acidity increases. Soils having a pH of 3 or 4 are considered highly acid, those of 8 or 9 highly alkaline. Some plants thrive in acid soils. Others like neutral or slightly alkaline soils. Thus, pH means a great deal to the development of the plant.

Lignin has a pH between 2 and 3 as it comes from the percolator where the wood is broken down. Hence, it can be added to soils having an acid deficiency. Such use might be a sizeable outlet for lignin resulting from manufacture of waste wood into molasses or ethyl alcohol. Disposal of the lignin by-product from this process could be as troublesome a problem as sawdust and slab disposal at a sawmill. Experimental use of lignin for golf greens and other horticultural uses points the way for profitable use of this by-product.

LIGNIN FOR GOLF GREENS

Experimental use of lignin as a soil conditioner has indicated that it is a satisfactory substitute for peat moss in the construction of golf greens. Three greens (15, 1 and 9) of the Missoula Country Club, Missoula, Montana, were built between September 2 and 5, 1947. The base for the three greens was

similar, consisting of three inches of sandy top soil, the area of each ranging from 4000 to 4500 square feet. Construction of the seed bed for each of the three greens was as follows:

Green 15: One part (by volume) of lignin, two parts of sand, and six parts of black loam soil spread uniformly over the base for a depth of four inches.

Green 9: Finish consisted of (a) east half same as green 15, (b) west half two parts sand, six parts black loam soil laid on approximately two inches of finely shredded peat moss.

Green 1: Was finished the same as west half of green 9 over its entire area. This green has been designated as the check plot; green 15 the lignin plot; and green 9 the lignin-peat moss plot.

Origin of Materials Used

Sand from the Bitterroot river channel was used on all plots and would be classed as a good grade of plaster sand. The black loam was alluvial soil from the Rattlesnake creek bottoms near Missoula. The lignin came from the wood molasses pilot plant of the Forest Products Laboratory, Madison, Wisconsin, as a by-product of the sulphuric acid hydrolysis of Douglas-fir hogged fuel containing about 25-percent bark. Neutralization of the lignin with lime fixed the pH at 4.5 at the time of use. The peat moss came from a Seattle, Washington firm, while the grass seed was a mixture furnished by O.M. Scott & Sons Company, Marysville, Ohio.

Results of Experiment

The summer of 1950 was the third year these three greens have been used. Just prior to the 1950 playing season, Professor F. N. Harrington, Head of the Horticulture Department. Montana State College, inspected them and found no significant difference in the quality of the turf. The golf course superintendent has made close observations and reports no significant difference in their playing qualities, or in the maintenance job on them.

While observations for a period of three years may not be conclusive, there are strong indications that lignin is a satisfactory substitute for peat moss. The competitive price situation would, of course, govern. Peat moss retails for $80 per ton at Missoula. Lignin might well become an important by-product if sold for only $10 per ton at the plant.

LIGNIN FOR GREENHOUSES AND STRAWBERRY CULTURE

Professor F. N. Harrington, Head Horticulture Department, Montana State College, Bozeman, Montana, has explored the greenhouse use of lignin and its place in strawberry culture. He reports as follows on his lignin experiments:

Two lots of lignin have been used by the Horticulture Department in various tests. The first lot was not treated with lime to correct acidity and therefore had a pH of about 3. The lot used the past year had been treated with lime to raise the pH to 6.

The work with lignin has consisted of combining it with potting soils as well as applying it to bench culture in the greenhouses. Amounts used have varied from a low of 10 percent by volume to a high of 50 percent. Analyses have been made of its effect on the pH of the soil mixture, conductivity, percent nitrogen and phosphorous, also measurements on growth and product produced.

Effect of Lignin on Soil

The lignin imparted a characteristic color and texture to the soil, and growth reaction was favorable. The physical condition of the soil was particularly improved and its pH was reduced, directly in accordance with the rate of application of lignin. Also, conductivity of soil was reduced, meaning a reduction of salts. The percent of nitrogen and ppm of phosphorous were also reduced, possibly indicating better utilization of nutrients.

Definite detrimental results came in potting soils when too large quantities of lignin were used in the soil mixture. Quantities up to 10 percent improved physical conditions and lowered the pH somewhat into a more desirable range than exists in our average soils, and plants appeared to do well.

Lignin has promise for greenhouse work. Whether the low pH lignin, or that corrected to 6, is best for other Montana soils remains to be proved. This report especially deals with the low pH of lignin.

Effect of Lignin on Chrysanthemums

Lignin was applied to the soil in a greenhouse bench for "mums" at the rate of 10 percent by volume. Growth reactions were favorable. Treatments involving lignin produced the greatest total weight, the greatest weight per stem, and the highest yield per square foot of bench space. Stem length and breadth of flower were also slightly greater. These results were obtained with the first lot of lignin - that which had not been treated with lime. A second year's work with the lignin, to which lime had been added, did not give equal results.[1/]

1/ Results of the third year's work using untreated lignin have duplicated the favorable results obtained the first year.

Most Montana soils have a pH above 7. This indicates that one of the merits of lignin might be in the way of correcting the pH of greenhouse soils.

Lignin for Strawberry Culture

Lignin was tried as a mulch on strawberries. It appears undesirable for such use since the lignin sticks to the berries. Lignin was applied to soils at the Horticulture Branch Station and worked in as a soil improvement measure. We have no results to report as yet.

It is planned to issue Research Notes from time to time recording the progress in the use of lignin as a soil supplement.